PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : E04B 1/343, 1/348	A1	(11) International Publication Number: WO 00/36238
		(43) International Publication Date: 22 June 2000 (22.06.00)

(21) International Application Number: PCT/NO99/00286

(22) International Filing Date: 17 September 1999 (17.09.99)

(30) Priority Data:
19985885 15 December 1998 (15.12.98) NO

(71) Applicant *(for all designated States except US)*: HEIMDAL ENTREPRENÖR AS [NO/NO]; Terminalen 2, N–7080 Heimdal (NO).

(72) Inventor; and

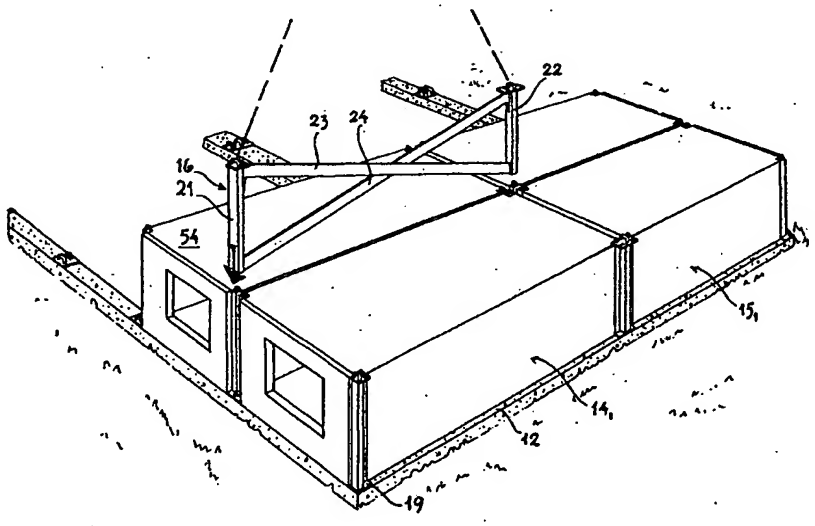
(75) Inventor/Applicant *(for US only)*: ANDERSON, Leif, Per, Roland [SE/SE]; Bögatan 39A, S–412 72 Göteborg (SE).

(74) Agent: CURO AS; P.O. Box 38, N–7231 Lundamo (NO).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: BUILDING SYSTEM FOR ERECTING OF BUILDINGS



(57) Abstract

Building system for erecting semi–permanent buildings, such as hotels, offices and hospitals. Prefabricated modular elements that each constitute a part of the building are stacked on top of each other in rows arranged against each other. The modular elements (14, 15) are manufactured to be self–supporting without the need to carry any external vertical force. The modular elements (14, 15) are arranged to be stacked without any reciprocal transfer of forces between the elements. The modular elements (14, 15) are arranged to be attached to the surrounding parts of the building construction in a detachable manner. Supporting pillars (21, 22) are arranged to manage forces caused by the weight of overlying modular elements. The supporting pillars (21, 22) are arranged to be fastened to an underlying fastening means or to an underlying supporting pillar in a detachable manner.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

Building system for erecting of buildings

The present invention concerns a building system for erecting permanent and semi-permanent buildings according to the introductory part of claim 1, particularly for purposes like apartment buildings, hotels, hospitals, schools, kindergartens and office buildings. The invention especially relates to a building system for erecting buildings with two or more floors. The invention also concerns a supporting element and a module element for such a building system.

Background

It is previously known to assemble buildings by stacking prefabricated modular elements on top of each other. This construction principle has disadvantages with respect to limitations of the construction height and with respect to the required strength of the lower modular elements. A particular disadvantage relates to the fact that such buildings become permanent without any practical possibility of their disassembly without damaging the module elements. Thus, removal of the buildings are time consuming, and an effective reuse of the modules for new buildings is not possible.

It is also well known to erect buildings by establishing a support structure and thereafter introducing modular room elements sideways into the raised support structure. This building principle, however, is complicated and requires a strong support structure that can withstand both heavy weight and side forces from wind.

Object

The main object of the present invention is to provide a building system for erecting permanent and semi-permanent buildings, wherein the buildings can be assembled and disassembled easily and without damaging any of its components. It is thus an object to create a basis for new use, redesign and reuse of the modular elements and the other elements that are included in the construction.

It is also an object to create a building system that makes it possible to use similar modular elements for all floors without having to consider particularly the weight placed on the lower modular elements of the building.

It is a further object to establish a building system where a modular element, which is designed to be self supporting only, can be included in the building in such a way that it contributes to the total strength of the building.

It is also an object to establish a building system whereby it is possible to disassemble the building e.g. for a factory upgrade or redesign, or to convert a school house which may have become superfluous, to apartments for elderly people.

It is therefore important that both the assembly and disassembly can be completed rapidly so that time constraints and environmental requirements are easy to fulfill. The purpose of the present invention is to improve the versatility of such buildings and, in addition, to reduce the number of parts that have to be destroyed at the disassembly by making most parts reusable.

The invention

The basic form of the invention is stated by claim 1.

By "modular element" is meant any kind of building element that can be prefabricated and assembled into a building in the phase of assembly, especially an element that is prefabricated more or less identical in larg numbers. Modular elements include rooms for overnight stay in a hotel/ motel, office rooms, classrooms for a school, apartment rooms, patient rooms for a hospital, parts of elevator shafts, parts of stairway housings etc.

It has been proven that such a building has great advantages with respect to costs of assembly, flexibility in design, reuse and with respect to the technical aspects of its construction. Also, it provides the possibility of manufacturing modular elements with

minimal required but carefully calculated necessary strength required, independent of which floor of a higher building it will be placed into.

In addition the present invention provides the possibility of reusing such elements without the need for any reconstruction or oversizing (over designed safety factor), still independent of floor level. This improves the degree of real recovery without redesign of buildings assembled according to the building system according to the invention. In practice one can achieve a degree of recovery of more than 90% in combination with a high degree of versatility, which implies a high degree of freedom with respect to the disassembly and reuse of the modular elements and with respect to the reuse of the elements without the need for any change.

In situations where the modular elements of a building can not be reused, either due to change of use or as a consequence of new requirements of insulation etc., the invention provides the possibility of performing an industrial renewal and/ or redesign.

The invention also provides the possibility of assembly within a building construction site without the use of scaffolding. The building assembly can take place from the top of the modular elements as the assembly progresses in height. The interconnection between the separate module elements, e.g. of electrical cables, water and sanitary outlets etc. can take place after the assembly is complete, from inside each of the separate modular elements.

Several advantageous embodiments of the building system are disclosed by the claims 2-8.

The invention also concerns a supporting element as stated by claim 9. Such a supporting element provides the particular advantage that it allows assembly from the top side of the modular elements without having access to the underside. Further details of the supporting element are disclosed by claims 10 and 11.

Finally the invention comprises a modular element as stated by claim 12. Such a modular element provides the particular advantage that construction can be performed with a carefully precalculated size which determines minimal required strength and still with the benefit that the module contributes to the total strength of the building, especially to withstand forces in a horizontal direction. An especially advantageous embodiment is disclosed by claim 13.

Example

In the following detailed description the invention is more closely described with reference to the accompanying drawings, where:

Fig. 1 shows a vertical section through a six-floor high semipermanent building which is built with the building system according to the invention,

Fig. 2 shows the start-up of the assembly of a semi-permanent building according to the invention, where there are two rows of stacked modular elements placed against each other,

Fig. 3 shows an enlarged and sectionalized part of a supporting pillar according to the invention, said pillar being a part of the supporting and locking element shown by fig. 2,

Fig. 4 shows a vertical section through the support pillar shown by fig. 3, while

Fig. 5 shows a horizontal section through the supporting pillar of fig. 4, with adjacent parts of two modular elements according to the invention.

Figure 1 illustrates a building 11 erected on a base 12 e.g. a concrete base. Two rows have been stacked, each with six modular elements 14_1 -14_6 and 15_1 -15_6, on top of each other. Each row may comprise two or more stacks in a row, as further shown on fig. 2. In the sectionalized, left part of figure 1 is shown a supporting and locking element 16 extending between adjacent modular elements and which can be used externally on the modular elements facing a front. Details of such a supporting and locking element 16 are shown by fig. 2.

The modular element can be a room of an apartment, a classroom of a school, a guest room for a hotel or motel, a patient room for a hospital or a patient care institution, an office room for an office building or other forms of elements for buildings to be erected

in several floors, e.g. elevator shafts and stairway housings, parts of larger rooms where the modules are missing one or more walls, elements for stands and rooms for storage houses.

The size of the modular elements can be arbitrary, but within the parameters defined by the building system, i.e. with a fixed height from floor to floor and with dimensions which by regulation are adapted for reuse, so that modular elements from different buildings can be combined with each other. The ideal situation is to develop a regulatory system that provides maximized possibility for the reuse of the modular elements without any changes. The invention will, however, make it economically feasible to rebuild the elements from one building so that they are adapted to another and differently dimensioned building. In this way the invention provides the architect a certain degree of freedom with respect to variations in dimensioning without forfeiting the main advantages of the building system.

At the upper edge of the building 11 a removable roof truss construction 17 is mounted for supporting a sheet roof 18.

Fig. 2 illustrates the assembly of the first floor of a building according to the present invention. To the base 12 grip members or fastening means 19 are attached either by way of casting or by securing with anchor bolts. Grip members 19 are localised in positions corresponding to the corners of the respective modular elements 14, 15 when these are put into place. The grip members 19 are shown in a modified form by fig. 3, and will be described in further detail below. Fastening means can be designed with a first mounting hole which is oversized in order to perform the first adaption of the position in both sideways directions and in the vertical direction, and with a second mounting hole which has a tight fit for a fastening bolt. This can be performed in a known manner.

The supporting/locking elements 16 have a pillar 21, 22 at each end, which will also be described in further detail with reference to fig. 3. The two pillars 21, 22 are attached by two crossbars 23, 24 of plate steel, which hold the pillars 21, 22 together and

provides support so that the force on top of one pillar is transferred to the foot of the neighbouring pillar. The figure shows how a supporting/locking element 16 is being lowered down into the space between two modular elements. To protect against accidents, fences 55 may be utilized during the mounting process.

At each corner of a modular element the upper end of a fastening bracket 25 extends as shown more closely by figure 4 together with some other details of the corner construction.

Figure 3 illustrates a grip member 19 for an intersection between four modular elements and a corresponding pillar 21 for a supporting/ locking element 16. The grip members 19 which in figure 4 is shown in an embodiment 19' for use in a frontal position has a base plate 26 that carries two pairs of extending inverted U-shaped hoops 27, 28 placed side by side with a space in between each pair. Between these two pairs is localized another inverted U-shaped hoop 29 with a flat top and a square recess 30 in its top. The base plate 26 is either provided with downwards extending grip claws (not shown) to be secured by casting into a base, or with a hole for an attachment bolt. The co-operative function with the adjacent elements will be described herein below.

The pillar 21 is arranged on top of a supporting tube 31 with rectangular cross-section (see fig. 5). On its top is arranged a cover plate 32 across its axis, said cover plate extending outwards (over) both longitudinal sides, or over one longitudinal side when used at a front module. In a lower part of the supporting tube 31 is arranged a fill plate 33 connected to the cover plate 32 by a central tubing 34 with room for a fastening bolt 35. The fastening bolt 35 has at its lower end a hammerhead 36 e.g. according to DIN261, while the upper end is threaded for a nut 37 over a lock washer 38 with extensions that can constitute a support base against a pair of locking pins 39.

During assembly i.e. the lowering of the supporting/lockin element 16 with the two pillars 21, 22, the lower part of the tubing 31 will be positioned down onto the U-hoop 29 of the fastening means 19 to rest against the base plate 26. The hammerhead 36 of the fastening bolt 35 will be lowered into the square recess 30 on top of the U-hoop 29

and turned 90 degrees into locking connection with the U-hoop. At the same time two square holes 40 and 41 in the cover plate 32 are being positioned down over two "ears" 42 and 43 which extend up from the fastening bracket 25 of the adjacent modular element 14, 15. The "ears" 42, 43 are two U-hoops arranged upside down corresponding to the U-hoops 27, 28 on the fastening means 19, and with a square form that fits the square holes 40, 41. More details of the fastening bracket 25 are shown by fig. 4 and elaborated herein.

By further stacking of modular elements 14, 15 the fastening bracket 25' of the next level modules will come to rest against the supporting/locking element 16, which means that it will transfer its weight to the pillars 21, 22 as shown in fig. 4. The pillars 21, 22 will thus fill a double function, they will support the load weight from the modular elements 14, 15 above so that these are lying without any load from floor to floor, whereas all load weight is being transferred over the pillars 21, 22. At the same time, the pillars 21, 22, or more precisely the bolts 35, manage the tensional forces, so that forces in an upwards direction caused by wind forces against a tall building, will be managed without any loads being transferred to the separate modular elements.

This means that each modular element can be designed to be self-supporting only, and without having to withstand any recipovical transfer of forces between the elements. In cases where modular elements with an open side are to be used, it will be possible to secure the roof construction of the element to an overlying supporting/locking element 16, so that this takes over part of the support function.

Fig. 4 illustrates the corner of a modular element 14, 15 with a fastening bracket 25. The fastening bracket 25 is arranged on top of a supporting tube 44 with rectangular cross-section (see fig. 5) which has been lowered down onto the lower edge of the modular element to rest against the cover plate 32 of a grip member 19 (fig. 3) or an underlying pillar 21, 22. The supporting tube 44 is shut at its upper end by means of an end plate 45 that serves as a base for the "ears" 42, 43 which in addition is locked with a through running bolt 46. In fig. 4 is also shown how the cavity in the preferably steel formed pillar 21, 22 may be filled with concrete 47 or another non-mmelting heat

resistant material. The fastening bolt 35 is during mounting, tightened in such a manner that it sets the tubing 31 under a low initial tension.

The principle for assembly is the same for all floors, a set of or layer of modular elements 14, 15 corresponding to one floor level is placed one by one to engagement between the upwards extending ears 42, 43 of an underlying set of moduare elements and the fastening brackets 25 of an overlying set of modular elements. This ensures the transfer of sideways forces between the modular elements and the pillars 21, 22 as well as the transfer of the load weight to the pillars. For the transfer of sideways forces (horizontal forces) between the roofs and the floors of the modular elements, the crossbars 23, 24 contribute to the sideways stability of the building. The floor 53 and the roof 54 of the modular elements serve as rigid plates and contribute to the transfer of horizontal forces to the spaces where the crossbars are arranged, without the need for any oversizing.

Thereafter a supporting/locking element 16 is lowered into each space between neighbouring elements, and there secured by means of the fastening bolts 35. In this way a base is established for the next layer or floor of modular elements.

Disassembly takes place by the reverse procedure. This means that the modular elements and the building can be taken apart without any damage or other unwanted effect due to the assembly or disassembly. In this way the invention makes it possible to reuse both the modular elements and the supporting/locking elements of a regulated building.

Fig. 5 shows how the groove at the corner between two modular elements 14, 15 can be used to isolate the support construction, i.e. the pillars 21, 22, against fire. A groove 48 can be filled with a fire insulating and heat resistant material 49 like rock wool or other special isulating material. This can surround both the pillars 21, 22 and the supporting tube 44 for each corner of a modular element 14, 15. Between the supporting tubes 44 is also arranged a sealing tube 50. The groove 48 is, on its outside covered by a covering plate 51 to provide a smooth outer surface.

The invention provides a series of advantages, both technical, economic and environmental. The most important is the versatility in use. The invention makes it possible for the first time to build semipermanent tall buildings, where it is possible to reuse the main part of the elements without the need for any redesign. Assembly and disassembly can take place within acceptable economic time frames , while simultaneously maintaining the possibility to performe environmental or other adjustments of the modules between disassembly and the reuse. The invention makes it possible to erect versatile buildings at lower costs since the reuse allows budgeting with a higher second hand value for temporary buildings. This again implies that the planning can be made simpler both technically and administratively.

Modifications

The example above can be modified in several ways. The pillars 21, 22 may be designed as supporting tubes with a C-profile. They may further be arranged as supporting tubes that face the front. The tubes 32 and 44 in the examples are made of steel. It may also be convenient to use types of composite materials that are not weakened when exposed to high temperatures.

The ears 42, 43 may be pins which extends upwards with tapered upper ends.

In stead of using fastening bolts 35, the locking element may be arranged at the lower edge of each pillar 21, 22 , e.g. as a wedge that is arranged to enter a recess, and which may be positioned from above by means of an activation rod without any load weight being transferred to the activation rod. Such a locking element would need the ability for removal to be performed in a similar manner.

If the requirement of supporting elements which may be positioned after the floor of modular elements has been assembled is fulfilled, one could also foresee the possibility that fastening means could be activated from inside the modular elements to secure the lower part of each supporting element or pillar to the underlying part of the construction. The main advantages of the invention are then still maintained, with covered mounting holes inside the modular elements being the only notable disadvantage.

Claims

1. Building system for erecting semi-permanent buildings, especially for erecting tall buildings for uses such as hotels, offices, hospitals and patient care purposes, where prefabricated modular elements that each constitute a part of the building, like hotel rooms, classrooms, kindergarten rooms, patient rooms, office rooms or parts of elevator shafts or stairway housings are being stacked on top of each other and with means for assembly that extends between the floors,
characterised in that
-the modular elements (14, 15) are manufactured substantially similarly in order to be self-supporting without the need to withstand any excessive external vertical force,
-the modular elements (14, 15) are arranged to be stacked without any significant reciprocal transfer of forces between the elements,
-the modular elements (14, 15) are arranged to be attached to the surrounding parts of the building construction in a detachable manner,
-supporting pillars (21, 22) are arranged to manage forces caused by the weight of overlying modular elements, on top of which another modular element may be positioned when the supporting pillars have been placed in the intended positions,
-the supporting pillars (21, 22) are arranged to be fastened to an underlying fastening means or to an underlying supporting pillar in a detachable manner, and that
-the top of each supporting pillar (21, 22) is provided with a grip member (19, fig. 3) which may be brought into engagement with an adjacent part (25) of a modular element (14, 15) in order to transfer horizontal forces to and from this element.

2. Building according to claim 1,
characterised in that the supporting pillars (21, 22) are designed to extend over one floor and are provided with fastening means (36) at a lower end, said fastening means n being brought into releasable locking engagement with an underlying hoop-shaped fastening member (29).

3. Building according to claim 2,
characterised in that the supporting pillars (21, 22) have a longitudinally positioned fastening bolt (35) with a head (36) for attachment to an attachment point (27, 28; 42, 43) which extends upwards from a base (19, fig. 1) or from an underlying pillar (21, 22, fig. 3).

4. Building according to claim 2 or 3,
characterised in that two supporting pillars (21, 22) are mutually connected, by means of crossbars (23, 24), for the transfer of sideways forces.

5. Building according to anyone of the claims 1 to 4,
characterised in that each modular element (14, 15) at each corner has an upwardly extending fastening element (42, 43) which is arranged to be engaged into the adjacent part of a supporting pillar (21, 22) for the transfer of sideways forces.

6. Building according to claim 5,
characterised in that the upwardly extending fastening element (42, 43) is connected to a fastening bracket (25) by means of a vertical supporting tube (44) which at its lower end is arranged to rest against an underlying supporting pillar (21, 22) or against a base.

7. Building according to anyone of the claims 1 to 6,
characterised in that the supporting pillars (21, 22) are made of steel and have an internal cavity which is filled with a non-melting material with high heat capacity, such as concrete.

8. Building according to anyone of the claims 1 to 7,
characterised in that the supporting pillars (21, 22) are surrounded with a fire insulating and fire resistant material.

9. Supporting element for semi-permanent building, especially for a building according to claim 1, **characterised** in that
- the element has a length that equals the height of one floor,

- the element is arranged to be inserted down between two assembled modular elements (14, 15) to support vertical loads from overlying modular elements, and that it has, at its lower edge, a detachable grip means (36) which may be activated from the upper end of the supporting element in order to bring the supporting element (21, 22) into engagement with an underlying part of the building construction.

10. Supporting element according to claim 9, **characterised** in that it comprises a tubing (31) which is able to manage load weight and an internal rod (35) which can manage tensional forces, wherein a material with high heat capacity, such as concrete is filled into the cavity between the tubing and the rod.

11. Supporting element according to claim 9 or 10, **characterised** in that it is joined in pairs (21, 22) connected by means of a crossbar (23, 24) at a distance between the separate elements which corresponds to the length of a modular element.

12. Modular element for use when erecting buildings according to claim 1, with a floor construction (52) which supports side walls and an overlying flat roof (53), **characterised** in that it comprises supporting tubes (44) at each corner, said supporting tubes at their upper ends having fastening means (42, 43) that can be brought into engagement with the supporting element (21, 22).

13. Modular element according to claim 12, **characterised** in that the supporting tubes (44) are arranged to support the roof (53) so that at least some of the side walls may be designed with reduced strength or may be removed.

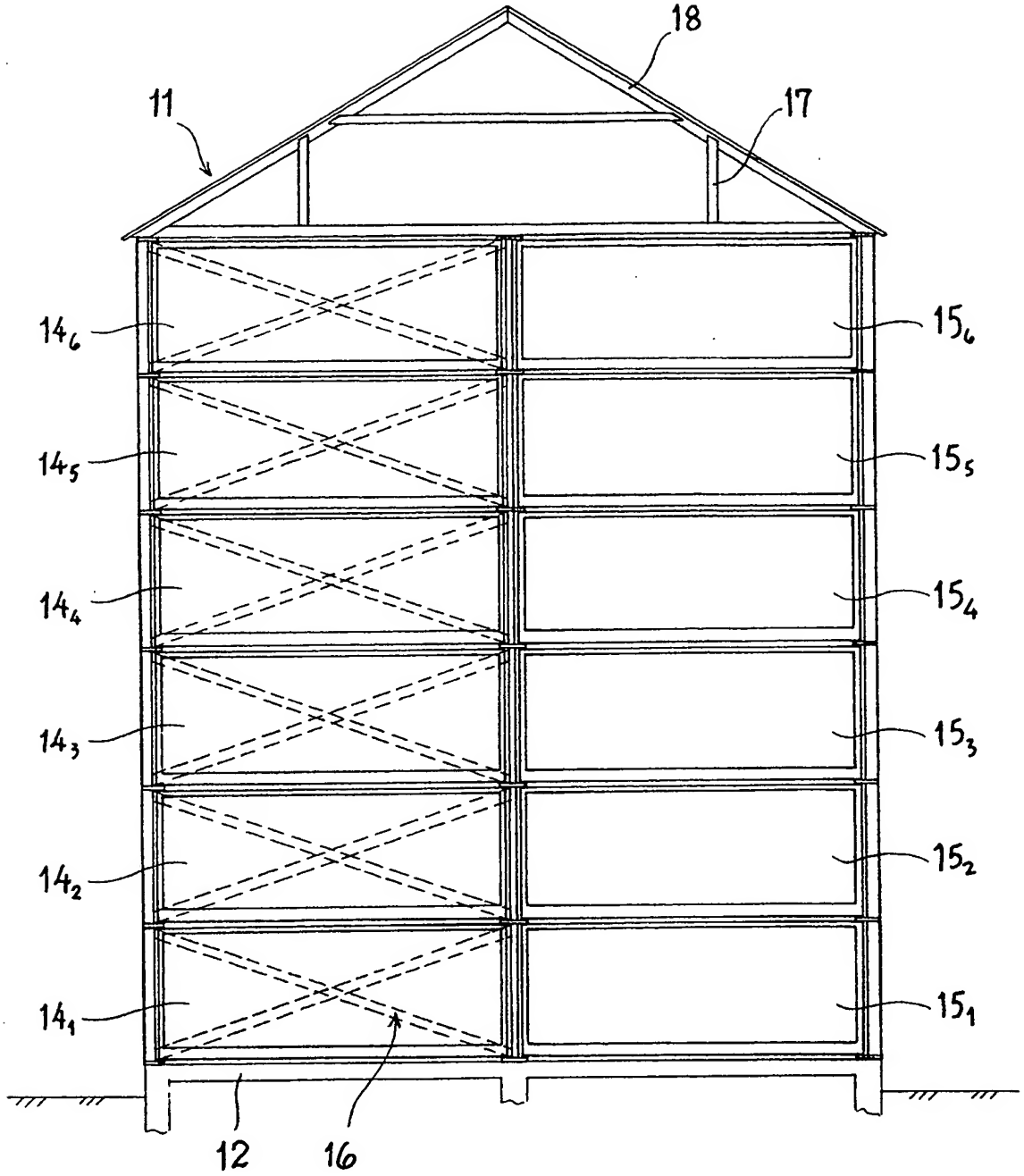


Fig.1

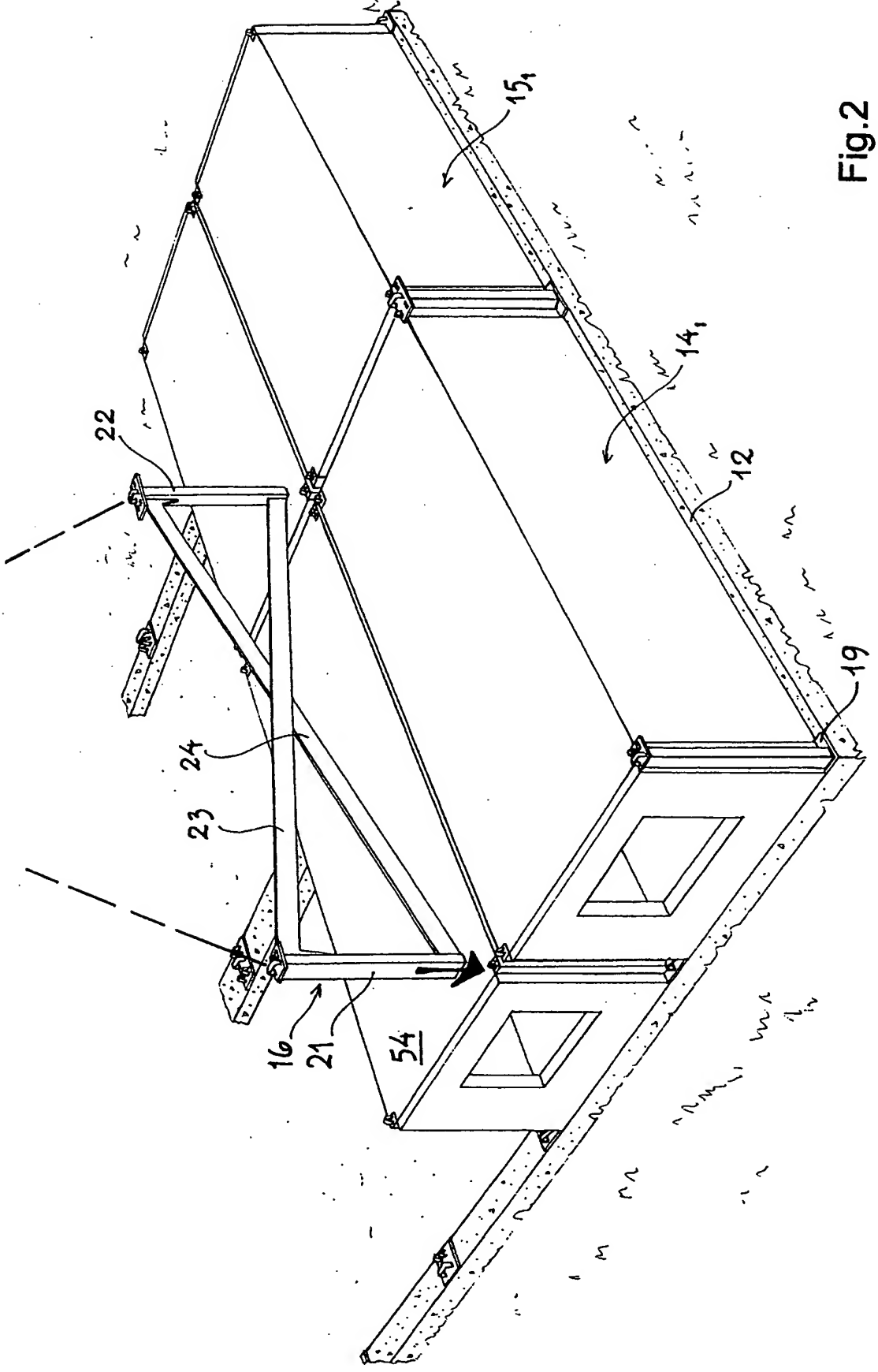


Fig.2

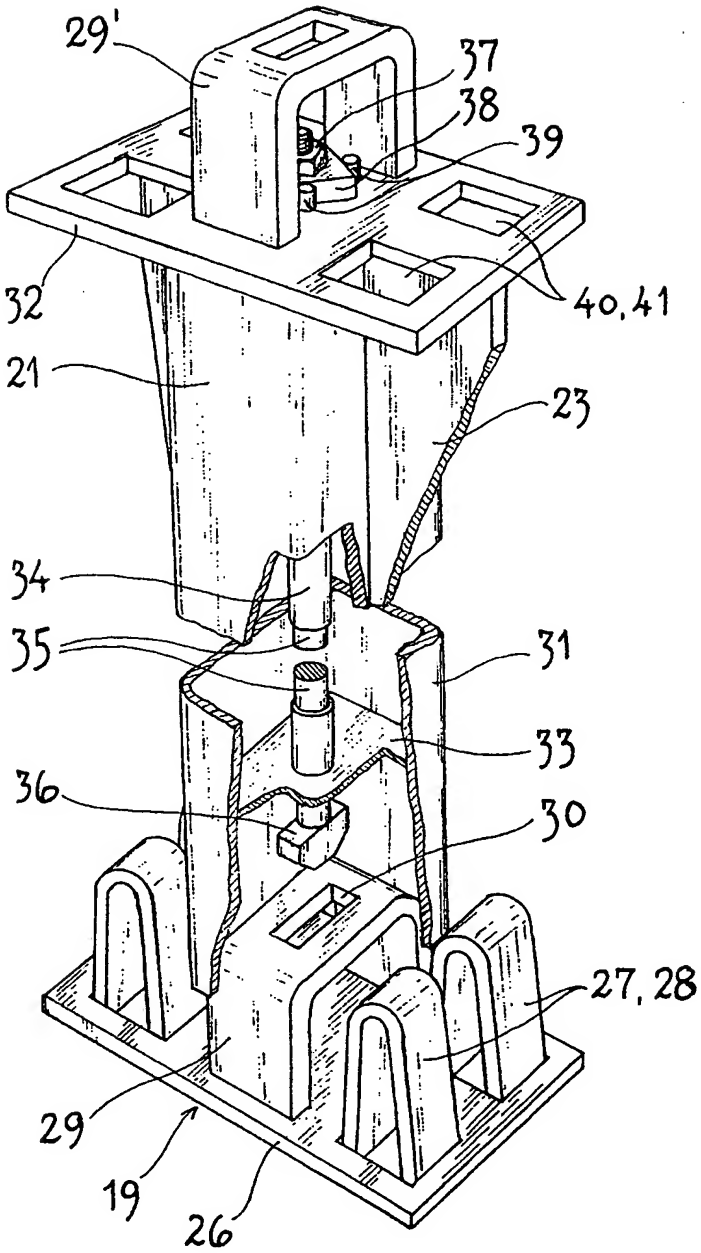


Fig.3

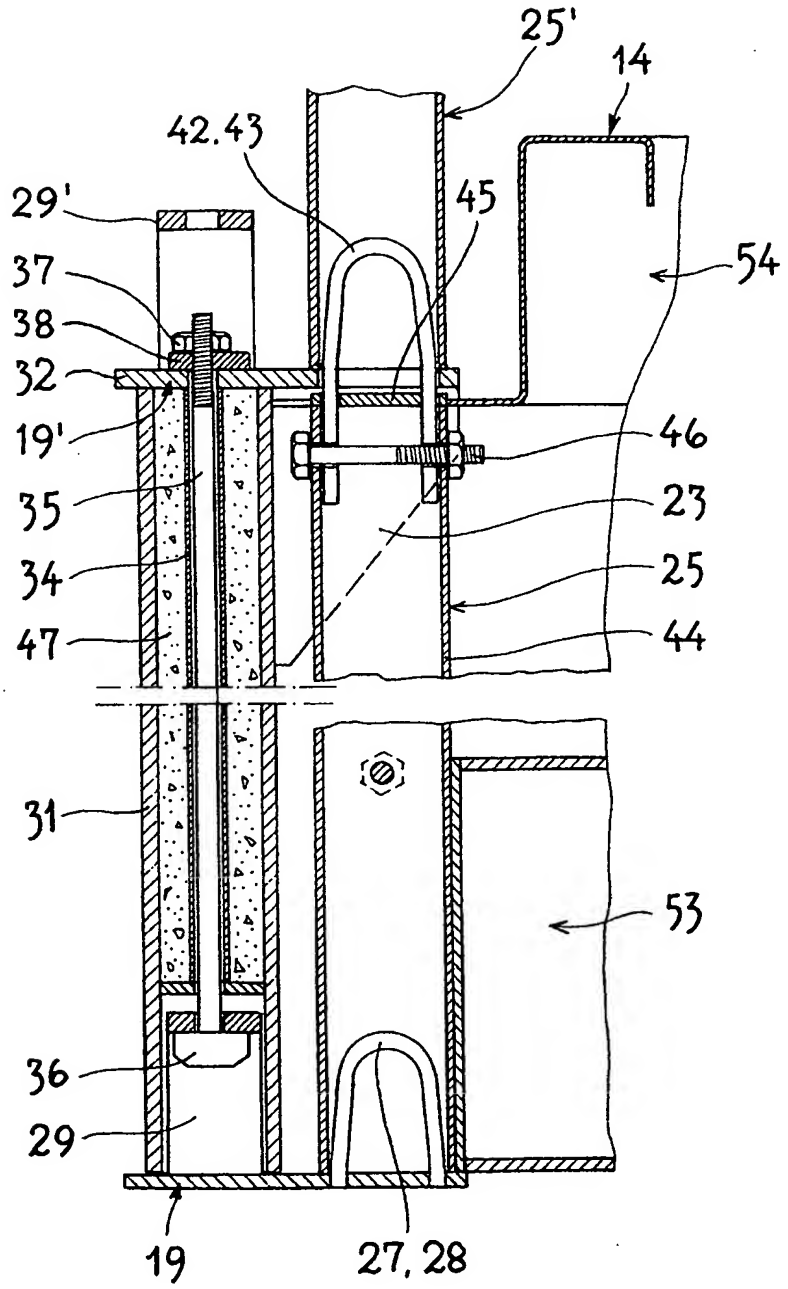

25'
14
42.43
45
29'
54
37
38
32
19'
46
35
23
34
25
47
44
31
53
36
29
19
27, 28

Fig.4

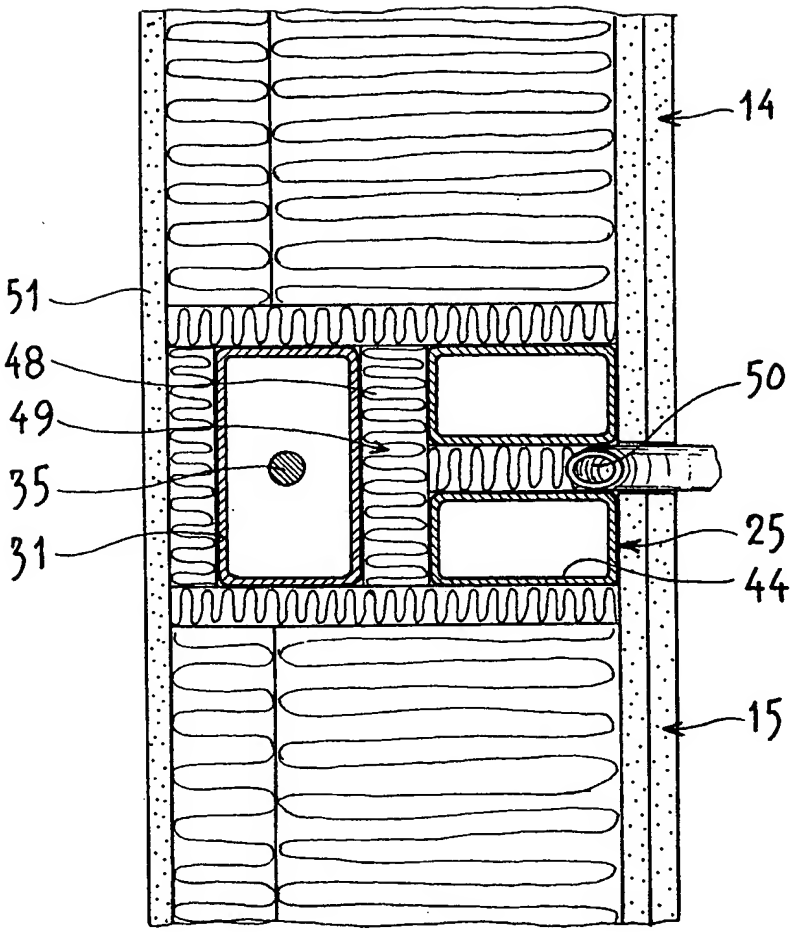


Fig.5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00286

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E04B 1/343, E04B 1/348
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2266907 A (MECH-TOOL ENGINEERING LIMITED), 17 November 1993 (17.11.93), page 7, line 12 - page 9, line 2, figures 1-3	1
A	GB 2192916 A (STRUCTURED STEEL SYSTEMS LIMITED), 27 January 1988 (27.01.88), page 2, line 130 - page 3, line 13, figure 5	1-13
A	US 3824750 A (A.A. ANTONIOU), 23 July 1974 (23.07.74), column 2, line 22 - line 58; column 3, line 28 - line 38, figures 1-3	1-13

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 December 1999	14 -02- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ingemar Hedlund / MR Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00286

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4599829 A (J.M. DIMARTINO, SR.), 15 July 1986 (15.07.86), column 3, line 17 - column 4, line 24, figures 1-3	1-13

--

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/NO 99/00286

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2266907 A	17/11/93	EP 0653525 A	17/05/95
GB 2192916 A	27/01/88	NONE	
US 3824750 A	23/07/74	NONE	
US 4599829 A	15/07/86	NONE	